

Claims

Claim 1 (previously presented) A process for producing $\text{CF}_3\text{CFHCF}_3$ comprising:

contacting a C-3 reactant comprising one or more of perhydrogenated or partially halogenated C-3 hydrocarbons with Cl_2 and HF in the presence of a first catalyst at a first temperature to form a C-3 product comprising a C-3 perhalogenated compound;

contacting the C-3 product with HF in the presence of a second catalyst at a second temperature to form a $\text{CF}_3\text{CCl}_2\text{CF}_3$ product, the $\text{CF}_3\text{CCl}_2\text{CF}_3$ product comprising a mole ratio of $\text{CF}_3\text{CCl}_2\text{CF}_3$ to $\text{CF}_3\text{CFCICCF}_2$ greater than 2:1;

contacting the $\text{CF}_3\text{CCl}_2\text{CF}_3$ product with HF in the presence of a third catalyst at a third temperature to form $\text{CF}_3\text{CCIFCF}_3$; and

contacting the $\text{CF}_3\text{CCIFCF}_3$ with H_2 in the presence of a fourth catalyst at a fourth temperature to produce $\text{CF}_3\text{CFHCF}_3$.

Claim 2 (original): The process of claim 1 wherein the first temperature is at least about 150°C , the second temperature is at least about 300°C , the third temperature is at least about 200°C and the fourth temperature is at least about 30°C .

Claim 3 (original): The process of claim 2 wherein the first temperature is from about 150°C to about 450°C , the second temperature is from about 300°C to about 550°C , the third temperature is from about 200°C to about 550°C and the fourth temperature is from about 30°C to about 275°C .

Claim 4 (previously presented): The process of claim 3 wherein the first temperature is at least about 220°C, the second temperature is at least about 470°C, the third temperature is at least about 470°C and the fourth temperature is at least about 185°C.

Claim 5 (previously presented): The process of claim 1 wherein, during the contacting of the C-3 reactant with the HF and the Cl₂, a molar ratio of the HF to the Cl₂ is from about 0.75:1 to about 8:1.

Claim 6 (previously presented): The process of claim 5 wherein, during the contacting of the C-3 reactant with the HF and the Cl₂, a molar ratio of the HF to the Cl₂ is at least about 4:1.

Claim 7 (previously presented): The process of claim 1 wherein, during the contacting of the C-3 reactant with the HF and the Cl₂, a molar ratio of the Cl₂ to the C-3 reactant is from about 8:1 to about 10:1.

Claim 8 (previously presented): The process of claim 7 wherein, during the contacting of the C-3 reactant with the HF and the Cl₂, a molar ratio of the Cl₂ to the C-3 reactant is at least about 8.2:1.

Claim 9 (previously presented): The process of claim 1 wherein, during the contacting of the C-3 reactant with the HF and the Cl₂, a molar ratio of the HF to the C-3 reactant is from about 6:1 to about 64:1.

Claim 10 (previously presented): The process of claim 9 wherein, during the contacting of the C-3 reactant with the HF and the Cl_2 , a molar ratio of the HF to the C-3 reactant is at least about 35:1.

Claim 11 (previously presented): The process of claim 1 wherein, during the contacting of the C-3 product with the HF, a molar ratio of the HF to the C-3 product is from about 6:1 to about 64:1.

Claim 12 (previously presented): The process of claim 11 wherein, during the contacting of the C-3 product with the HF, a molar ratio of the HF to the C-3 product is at least about 30:1.

Claim 13 (previously presented): The process of claim 1 wherein, during the contacting of the $\text{CF}_3\text{CCl}_2\text{CF}_3$ product with the HF, a molar ratio of the HF to the $\text{CF}_3\text{CCl}_2\text{CF}_3$ is from about 1:1 to about 30:1.

Claim 14 (previously presented): The process of claim 13 wherein, during the contacting of the $\text{CF}_3\text{CCl}_2\text{CF}_3$ product with the HF, a molar ratio of the HF to the $\text{CF}_3\text{CCl}_2\text{CF}_3$ is at least about 10:1.

Claim 15 (previously presented): The process of claim 1 wherein, during the contacting of the $\text{CF}_3\text{CClFCF}_3$ with the H_2 , a molar ratio of the H_2 to the $\text{CF}_3\text{CClFCF}_3$ is from about 0.2:1 to about 10:1.

Claim 16 (previously presented): The process of claim 15 wherein, during the contacting of the $\text{CF}_3\text{CClFCF}_3$ with the H_2 , a molar ratio of the H_2 to the $\text{CF}_3\text{CClFCF}_3$ is at least about 1.2:1.

Claim 17 (previously presented): The process of claim 1 further comprising, during the contacting of the $\text{CF}_3\text{CClFCF}_3$ with H_2 , contacting the fourth catalyst with water.

Claim 18 (previously presented): The process of claim 17 wherein the water is present in an amount from about 0.04 to about 12 percent by weight of the $\text{CF}_3\text{CClFCF}_3$.

Claim 19 (previously presented): The process of claim 18 wherein the amount is about 0.8 percent by weight of the $\text{CF}_3\text{CClFCF}_3$.

Claim 20 (previously presented): The process of claim 1 further comprising, during the contacting of the C-3 product with HF , contacting the C-3 product with Cl_2 .

Claim 21 (previously presented): The process of claim 1 wherein the first catalyst comprises chromium and a catalyst support.

Claim 22 (previously presented): The process of claim 1 wherein the second catalyst comprises chromium and a catalyst support.

Claim 23 (previously presented): The process of claim 1 wherein the third catalyst comprises chromium and a catalyst support.

Claim 24 (previously presented): The process of claim 1 wherein the fourth catalyst comprises palladium and a catalyst support.

Claim 25 (previously presented): The process of claim 1 further comprising, during the contacting of the C-3 reactant with HF and Cl₂, contacting the C-3 reactant with a diluent.

Claim 26 (previously presented): The process of claim 1 wherein, the C-3 product further comprises a halogenation by-product and, during the contacting of the C-3 reactants with the Cl₂ and the HF, the C-3 reactants further comprises the halogenation by-product.

Claim 27 (previously presented): A process for producing CF₃CFHCF₃ comprising:

contacting a C-3 reactant comprising one or more of perhydrogenated and partially halogenated C-3 hydrocarbons with Cl₂ and HF in the presence of a first catalyst at a first temperature to form a C-3 product comprising a mole ratio of CF₃CCl₂CF₃ to CF₃CFCICClF₂ greater than 2:1; and

contacting the C-3 product with HF in the presence of a second catalyst at a second temperature to form CF₃CCIFCF₃;

contacting the CF₃CCIFCF₃ with H₂ in the presence of a third catalyst at a third temperature to form CF₃CFHCF₃.

Claim 28 (original): The process of claim 39 wherein the first temperature is at least about 150°C, the second temperature is at least about 200°C, and the third temperature is at least about 30°C.

Claim 29 (original): The process of claim 40 wherein the first temperature is from about 150°C to about 300°C, the second temperature is from about 200°C to about 550°C, and the third temperature is from about 30°C to about 275°C.

Claim 30 (previously presented): The process of claim 41 wherein the first temperature is at least about 220°C, the second temperature is at least about 470°C, and the third temperature is at least about 185°C.

Claim 31 (previously presented): The process of claim 39 wherein, during the contacting of the C-3 reactant with the Cl_2 and the HF, a molar ratio of the HF to the Cl_2 is from about 0.75:1 to about 8:1.

Claim 32 (previously presented): The process of claim 43 wherein, during the contacting of the C-3 reactant with the Cl_2 and the HF, a molar ratio of the HF to the Cl_2 is at least about 4:1.

Claim 33 (previously presented): The process of claim 39 wherein, during the contacting of the C-3 reactant with the Cl_2 and the HF, a molar ratio of the Cl_2 to the C-3 reactant is from about 8:1 to about 10:1.

Claim 34 (previously presented): The process of claim 45 wherein, during the contacting of the C-3 reactant with the Cl_2 and the HF, a molar ratio of the Cl_2 to the C-3 reactant is at least about 8.2:1.

Claim 35 (previously presented): The process of claim 39 wherein, during the contacting of the C-3 reactant with the Cl_2 and the HF, a molar ratio of the HF to the C-3 reactant is from about 6:1 to about 64:1.

Claim 36 (previously presented): The process of claim 47 wherein, during the contacting of the C-3 reactant with the Cl_2 and the HF, a molar ratio of the HF to the C-3 reactant is at least about 35:1.

Claim 37 (previously presented): The process of claim 39 wherein, during the contacting of the C-3 product with the HF, a molar ratio of the HF to the C-3 product is from about 6:1 to about 64:1.

Claim 38 (previously presented): The process of claim 49 wherein the, during the contacting of the C-3 product with the HF, a molar ratio of the HF to the C-3 product is at least about 30:1.

Claim 39 (previously presented): The process of claim 39 wherein, during the contacting of the $\text{CF}_3\text{CClFCF}_3$ with the H_2 , a molar ratio of the H_2 to the $\text{CF}_3\text{CClFCF}_3$ is from about 0.2:1 to about 10:1.

Claim 40 (previously presented): The process of claim 51 wherein, during the contacting of the $\text{CF}_3\text{CClFCF}_3$ with the H_2 , a molar ratio of the H_2 to the $\text{CF}_3\text{CClFCF}_3$ is at least about 1.2:1.

Claim 41 (previously presented): The process of claim 39 further comprising, during the contacting of the $\text{CF}_3\text{CClFCF}_3$ with the H_2 , contacting the third catalyst with water.

Claim 42 (previously presented): The process of claim 53 wherein the water is present in an amount from about 0.04 to about 12 percent by weight of the $\text{CF}_3\text{CClFCF}_3$.

Claim 43 (previously presented): The process of claim 54 wherein the amount is about 0.8 percent by weight of the $\text{CF}_3\text{CClFCF}_3$.

Claim 44 (previously presented): The process of claim 39 further comprising, during the contacting of the C-3 product with HF, contacting the C-3 product with Cl_2 .

Claim 45 (previously presented): The process of claim 39 wherein the first catalyst comprises chromium and a catalyst support.

Claim 46 (previously presented): The process of claim 39 wherein the second catalyst comprises chromium and a catalyst support.

Claim 47 (previously presented): The process of claim 39 wherein the third catalyst comprises palladium and a catalyst support.

Claim 48 (previously presented): The process of claim 39 further comprising, during the contacting of the C-3 reactant with Cl_2 and HF, contacting the C-3 reactant with a diluent.

Claim 49 (previously presented): The process of claim 39 wherein, the C-3 product further comprises a halogenation by-product and, during the contacting of the C-3 reactant with the Cl_2 and the HF, the C-3 reactant further comprises the halogenation by-product.

Claim 50 (previously presented): The process of claim 1 further comprising, during the contacting of the C-3 product with the HF, contacting the C-3 product with a diluent.

Claim 51 (previously presented): The process of claim 1 further comprising, during the contacting of the $\text{CF}_3\text{CCl}_2\text{CF}_3$ product with the HF, contacting the $\text{CF}_3\text{CCl}_2\text{CF}_3$ with a diluent.

Claim 52 (previously presented): The process of claim 1 further comprising, during the contacting of the $\text{CF}_3\text{CClFCF}_3$ with the H_2 , contacting the $\text{CF}_3\text{CClFCF}_3$ with a diluent.

Claim 53 (previously presented): The process of claim 1 wherein the contacting of the $\text{CF}_3\text{CCl}_2\text{CF}_3$ product with the HF also forms a halogenation exchange by-product and, during the contacting of the C-3 product with HF, the C-3 product further comprises the halogenation exchange by-product.

Claim 54 (previously presented): The process of claim 92 wherein the halogenation exchange by-product comprises one or more of $\text{CF}_3\text{CCl}_2\text{CF}_3$, $\text{CF}_3\text{CF}_2\text{CF}_3$, and $\text{C}_3\text{F}_5\text{Cl}_3$.

Claim 55 (previously presented): The process of claim 1 wherein the contacting of the $\text{CF}_3\text{CCl}_2\text{CF}_3$ product with the HF also forms a halogenation exchange by-product and, during the contacting of the C-3 reactant with Cl_2 and HF, the C-3 reactant further comprises the halogenation exchange by-product.

Claim 56 (previously presented): The process of claim 94 wherein the halogenation exchange by-product comprises one or more of $\text{CF}_3\text{CCl}_2\text{CF}_3$, $\text{CF}_3\text{CF}_2\text{CF}_3$, and $\text{C}_3\text{F}_5\text{Cl}_3$.

Claim 57 (previously presented): The process of claim 1 wherein the first and the second catalysts comprise the same material.

Claim 58 (previously presented): The process of claim 1 wherein the first and the second catalyst comprise the same material as the third catalyst.

Claim 59 (previously presented): The process of claim 39 further comprising, during the contacting of the C-3 product with the HF, contacting the C-3 product with a diluent.

Claim 60 (previously presented): The process of claim 39 further comprising, during the contacting of the $\text{CF}_3\text{CClFCF}_3$ with the H_2 , contacting the $\text{CF}_3\text{CClFCF}_3$ with a diluent.

Claim 61 (previously presented): The process of claim 39 wherein the contacting of the C-3 product with the HF also forms a halogenation exchange by-product and, during the contacting of the C-3 reactant with Cl_2 and HF, the C-3 reactant further comprises the halogenation exchange by-product.

Claim 62 (previously presented): The process of claim 100 wherein the halogenation exchange by-product comprises one or more of $\text{CF}_3\text{CCl}_2\text{CF}_3$, $\text{CF}_3\text{CF}_2\text{CF}_3$, and $\text{C}_3\text{F}_5\text{Cl}_3$.

Claim 63 (previously presented): The process of claim 39 wherein the first and the second catalysts comprise the same material.

Claim 64 (previously presented): The process of claim 39 wherein the first and the second catalyst comprise the same material as the third catalyst.